Random Variables are unknowns that take on Real Values.

X for instance is binomial (a sum of ind. weighted coin flips, where heads = 1, tails = 0)

$$P(X=k) = \binom{n}{k} p^k (1-p)^{n-k}$$

functions of random variables are random variables.

$$Y = (X - E(X))^2$$

$$\sqrt{E(Y)} = se(X)$$

Expected Value

weighted average, represents central tendency

$$E(X) = \sum_k P(X=k) \cdot k$$

"average"

- equally likely outcomes
- n outcomes $P(X=k) = \frac{1}{n}$

$$E(X) = \frac{1}{n} \sum_k k$$

1 DRAW

1 3 3 4

X is a single draw from this box

k	$P(X=k)$
1	$1/4$
3	$2/4 = 1/2$
4	$1/4$

$$E(X) = 1 \cdot \frac{1}{4} + 3 \cdot \frac{1}{2} + 4 \cdot \frac{1}{4}$$
$$= 2.75$$

note this is the average of the box.

$$\frac{1+3+3+4}{4} = 2.75$$

Standard error

$$\sqrt{E\left[\left(X - E(x)\right)^2\right]}$$

$$Y = \left(X - E(x)\right)^2$$

j	$P(Y=j)$
$(1-2.75)^2$	$1/4$
$(3-2.75)^2$	$1/2$
$(4-2.75)^2$	$1/4$

$$\sqrt{\frac{1}{4} \cdot (1-2.75)^2 + \frac{1}{2}(3-2.75)^2 + \frac{1}{4}(4-2.75)^2}$$

$= se(\#draw) = se(X)$

$sd(box) = se(X).$

$E(box) = \#draws \cdot average$

$= \#draws \cdot E(X).$

$se(box) = \sqrt{\#draws} \cdot sd\,box.$

$= \sqrt{\#draws} \cdot se(X).$